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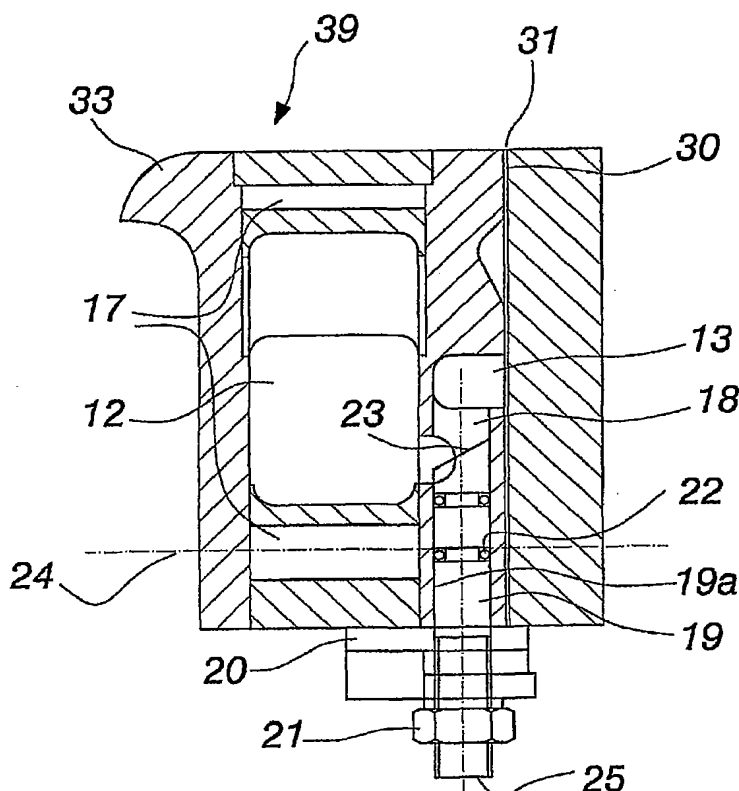
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(54) Title: PAPER/BOARD WEB COATING APPARATUS



(57) Abstract: The invention relates to a paper/board web coating apparatus, which is arranged to extend in its longitudinal direction (W) in the transverse direction of the web to be coated. The apparatus comprises a nozzle unit (1) having at least one feeding chamber (12) extending in the longitudinal direction (W) of the coating apparatus, into which chamber is conveyed coating colour by feeding means (4), and a nozzle slot (30) in flow communication with the said feeding chamber, the said slot also extending in the longitudinal direction (W) of the coating apparatus, and to which slot the coating colour is conveyed from the feeding chamber over the total longitudinal distance of the nozzle slot, and further conveyed out of the outlet opening (31) of the nozzle slot (30). The flow communication between the said at least one feeding chamber (12) and the nozzle slot (30) connected to it is formed by feed holes (14; 18) made in one wall of the feeding chamber, through which the coating colour can be conveyed to the nozzle slot. The nozzle unit has means (15, 16; 19) by which the effective area of the feed holes (14; 18) can be adjusted in order to accomplish transverse profiling of the amount of coating colour.



GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## Paper/board web coating apparatus

The present invention relates to a paper/board web coating apparatus, which is arranged to extend in its longitudinal direction in the transverse direction of the web to be coated, and which comprises a nozzle unit having at least one feeding chamber extending in the longitudinal direction of the coating apparatus, into which  
5 chamber is conveyed coating colour by feeding means, and a nozzle slot in flow communication with the said feeding chamber, the said slot also extending in the longitudinal direction of the coating apparatus, and to which slot the coating colour  
10 is supplied from the feeding chamber over the total longitudinal distance of the nozzle slot and further conveyed out of the outlet opening of the nozzle slot.

The aim of the present invention is to provide an improvement to a curtain coater intended for spreading the coating colour of a paper/board web.

15 The use of a curtain coater for coating paper or board webs is increasing, because it exerts much less force on the web than blade coating/rod coating and, consequently, causes fewer interruptions resulting from the breaking of the web being coated, and thus improves runnability. Curtain coating does not give the same  
20 smoothness as blade coating, but the coverage attained is better than that attained with blade coating.

Curtain coaters can be divided into slot-fed and slide-fed coaters. In a slide-fed curtain coater, the coating colour is supplied by means of a nozzle unit onto an  
25 inclined plane, along which the coating colour flows towards the edge of the plane, whereby a curtain is formed as the coating colour drips from the edge of the plane.

In slot-fed applicator beams, the coating colour is pumped via a manifold into a narrow vertical slot on the lip of which the curtain is formed and drips onto the web.  
30 The coating colour may be spread in one or more layers.

The curtain thus formed is guided by means of an edge guide, which is located on the edge of the feeding slot/feeding lip, as indicated by its name.

One problem with current coating colour curtain coaters is the limited size of the coating colour feed channels and, partly due to this, the difficulty of controlling the size of the flow slot. Controlling the transverse profile of the coating colour spread on the web to be coated in different situations is problematic also in a prior art curtain coater. Normally, there are no means for controlling the profile. When designing a coating beam, the shape of the feed channels is determined, by means of which the overall profile may be affected. When the properties and/or feeding volume of coating colour change, these have a distinct effect on the transverse profile which cannot be corrected. All imprecisions of manufacture also affect the profile irreparably.

Accordingly, one important aim of the present invention is to provide an improved curtain coater, which makes possible uniform feeding of coating colour over the total length of the nozzle unit, in the transverse direction (CD-direction) of the web being coated, the said feeding preferably being adjustable to different coating colours. To achieve this aim, the coating apparatus according to the invention is characterised in that the flow communication between the said at least one feeding chamber and the nozzle slot connected to it is formed by feed holes made in one wall of the feeding chamber, through which the coating colour can be conveyed to the nozzle slot, and that the nozzle unit has means by which the effective area of the feed holes can be adjusted in order to accomplish transverse profiling of the amount of coating colour.

A further, more general aim of the invention is to provide a spreading apparatus for spreading various fibrous or other liquids or coating colours in a paper/board or pulp machine environment.

The invention is described in greater detail in the following, with reference to the accompanying drawings, in which:

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Figure 1 shows a diagrammatic view of a nozzle unit of a multi-layer curtain coater according to the prior art,

- Figure 2 shows a diagrammatic, perspective view of a nozzle unit of a slide-fed curtain coater, which may be realised in accordance with the invention,
- 5 Figure 3 shows a diagrammatic, cross-sectional view of an embodiment of a nozzle part in a coater according to Figure 2, the nozzle part comprising a feeding chamber and a nozzle slot,
- Figure 4 shows a perspective view of the nozzle part according to Figure 3, and
- 10 Figure 5 shows a diagrammatic, cross-sectional view of another embodiment of the nozzle part of the nozzle unit of the curtain coater according to Figure 2.
- 15 Figure 1 shows diagrammatically the general structure of the nozzle unit of a known slide-fed multi-layer curtain coater. The nozzle unit is comprised of nozzle parts 3 and 3a, each of which has a feeding chamber 12 and an equalizing chamber 13, and a nozzle slot 30, which are machined in thick steel plate. The edge 33 of the outermost nozzle part 3a forms a feeding lip, over which the coating colour
- 20 discharged from the outlet openings 31 of the nozzle slots 30 and flowing along the upper surface of the nozzle unit is conveyed to form a coating colour curtain and to guide it by means of edge guides (not shown) onto the surface of the paper/board web to be coated which is travelling below the coater. The coating colour curtain formed extends across the web being coated.
- 25 Figure 2 shows the applicator beam 1 of a slide-fed curtain coater, which can be realised in accordance with the invention. The applicator beam comprises nozzle parts 3, 3a and 32 located on bearers 2 forming a supporting structure, the said nozzle parts together forming a nozzle unit, which has three nozzle slots 30 in the
- 30 embodiment shown that make multi-layer coating possible. The nozzle parts 3 and 32 are arranged movably on top of the bearers 2. In order to move the movable nozzle parts 3, 32, the curtain coater comprises a fixed support 5 resting on the bearers 2, on the other side of the said support, between the innermost nozzle part 32 and the fixed support 5, is a closing tube 6, and on the opposite side of the fixed
- 35 support 5 an opening tube 7, whereby by pressurising the closing tube 6, the

movable nozzle parts 3, 32 can be made to move towards the fixed nozzle part 3a to close the nozzle unit, and by releasing the pressure from the closing tube 6 and pressurising the opening tube 7, the movable nozzle parts 3, 32 can be made to move away from the fixed nozzle part 3a to open the nozzle unit, for example, to  
5 remove dried coating colour from the nozzle slot and/or the different chambers of the nozzle.

At one end of the nozzle unit are arranged feeder pipes 4 for the coating colour being fed, the said pipes opening into the feeding chambers. The substance being  
10 fed travels along the feeding chamber towards the opposite end, at which is optionally arranged a by-pass. When proceeding in the feeding chamber, the substance being fed moves at each point over the length of the feeding chamber to the equalizing chamber, and from there further to the nozzle slot 30, over the total  
15 longitudinal distance of the nozzle slot 30.

Figures 3 and 4 show one nozzle part solution according to the invention, in which there are feed holes 14 between the feeding chamber 12 and the equalizing chamber 13. The aim being to achieve as even as possible a profile for the substance flowing out of the nozzle, in the equalizing chamber 13 is arranged a  
20 profiling member 15, which is located on the surface of the equalizing chamber 13 comprising the feed holes 14, and extends over the length determined by the successive feed holes. The transverse position of the profiling member is adjustable in order to change the effective area of individual feed holes or groups of several feed holes for feeding the desired amount of coating colour into the equalizing  
25 chamber 13 at different points of its longitudinal direction. The transverse position of the profiling member can be changed by means of adjustment means 16, the operation of the adjustment means preferably being automated, whereby profiling during running will also be possible in the transverse direction of the object being coated. The mutual distance between the adjustment means in the longitudinal  
30 direction W of the nozzle part is, for example, 100-600 mm, preferably 150-300 mm. Reference numeral 17 denotes the water-space surrounding the feeding chamber. The profiling member makes it possible to control a considerably larger feed volume area with the same system of coating colour feed channels as a normal construction without adjustment. The profiling member also substantially reduces  
35 the accuracy of manufacture of the feed slot, and by means of it the transverse

profile can be accurately adjusted to be correct regardless of the properties of the coating colour and rates of flow. An additional advantage of the solution using a profiling member is that the equalizing chamber becomes a two-step one, which evens out any streaks resulting from the feed holes extremely efficiently. The structure is easy to implement in all feed slots, whereby all layers can be profiled irrespective of each other. The adjustment means 16 connected to the different feed slots are preferably at different longitudinal positions in successive feed slots, in which case they will not cause cumulative waviness to the overall profile of the coating colour.

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Figure 5 shows another nozzle part solution according to the invention, where in the feeding chamber 12 are formed feed holes 18 at a distance from each other in the longitudinal direction of the nozzle part, through which holes the coating colour is conveyed to the equalizing chamber 13. The feeding chamber 12 and the equalizing chamber 13 extend essentially over the total length of the nozzle part. In the embodiment shown, the feed hole 18 forms an angle between the feeding chamber 12 and equalizing chamber 13 and opens in the position shown in Figure 5 horizontally into the feeding chamber 12 and vertically into the equalizing chamber 13. In each feed hole 18 is, in addition, formed a bore 19a opening to the outside of the nozzle part, the said bore connecting with the vertical part of the feed hole 18, and in the bore being arranged a longitudinally movable adjusting pin 19, the inner end of which, which extends into the feed hole 18, is preferably bevelled. At the outer end 25 of the adjusting pin 19 is arranged an adjustment nut 21, by turning which the adjusting pin 19 can be moved in its longitudinal direction in order to change the effective cross-sectional area of the feed hole 18. In connection with the adjusting pin is arranged an adjustment plate 20, in which case, by removing the adjustment plate, the basic setting of the effective cross-sectional area of the feed hole can be changed to reduce the feed volume. The adjusting pin 19 is sealed in the bore 19a by means of gaskets 22. The mutual distance between the feed holes 18 in the longitudinal direction of the nozzle part is, for example, 100-600 mm, preferably 150-300 mm, for accomplishing the desired transverse profiling by changing the effective cross-sectional area of the feed holes. The operation of the adjusting pins is preferably automated, whereby profiling during running will also be possible in the transverse direction of the object being coated. Reference numeral 24 denotes the level of attachment of the assembly screws of the nozzle part. The

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assembly screws extend between successive bores 19a across the water-space 17 provided with the gasket means required.

5 The solution according to the invention may be realised as a single- or multi-layer coating apparatus, where the number of nozzle slots 30 may be, for example, 1 to 24.

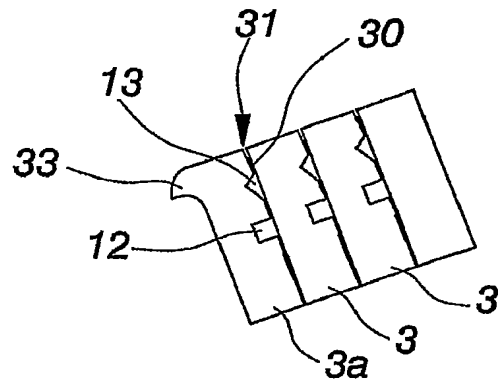


**Claims**

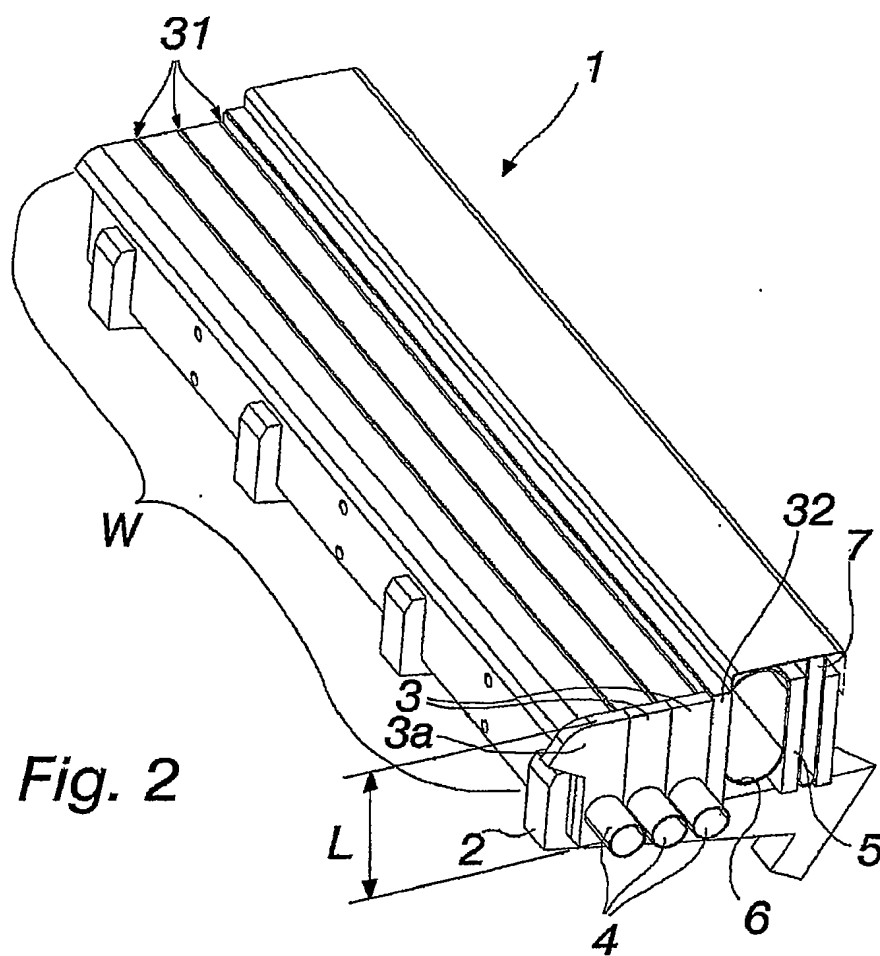
1. A paper/board web coating apparatus, which is arranged to extend in its longitudinal direction (W) in the transverse direction of the web to be coated, and  
5 which comprises a nozzle unit (1) having at least one feeding chamber (12) extending in the longitudinal direction (W) of the coating apparatus, into which chamber is conveyed coating colour by feeding means (4), and a nozzle slot (30) in flow communication with the said feeding chamber, the said slot also extending in the longitudinal direction (W) of the coating apparatus, and to which slot the  
10 coating colour is supplied from the feeding chamber over the total longitudinal distance of the nozzle slot and further conveyed out of the outlet opening (31) of the nozzle slot (30), **characterised** in that the flow communication between the said at least one feeding chamber (12) and the nozzle slot (30) connected to it is formed by feed holes (14; 18) made in one wall of the feeding chamber, through  
15 which the coating colour can be conveyed to the nozzle slot, and that the nozzle unit has means (15, 16; 19) by which the effective area of the feed holes (14; 18) can be adjusted in order to accomplish transverse profiling of the amount of coating colour.
- 20 2. A coating apparatus as claimed in claim 1, **characterised** in that between the said at least one feeding chamber (12) and the nozzle slot (30) connected to it is at least one equalizing chamber (13) which also extends in the longitudinal direction (W) of the coating apparatus and into which equalizing chamber the feed holes (14) open, and that as an adjustment means for the area of the feed holes, a profiling  
25 member (15) is arranged in the equalizing chamber (13), the said member being located on the surface of the equalizing chamber comprising the feed holes and extends over a length determined by successive feed holes, the said profiling member (15) being adjustable for changing the effective area of individual feed holes or groups of several feed holes for feeding the desired amount of coating  
30 colour into the equalizing chamber (13) at different points of its longitudinal direction.
3. A coating apparatus as claimed in claim 2, **characterised** in that the adjustment means of the profiling member (15) are adjusting bolts (16) extending from the  
35 outer surface of the nozzle unit (1) to the equalizing chamber (13), by means of

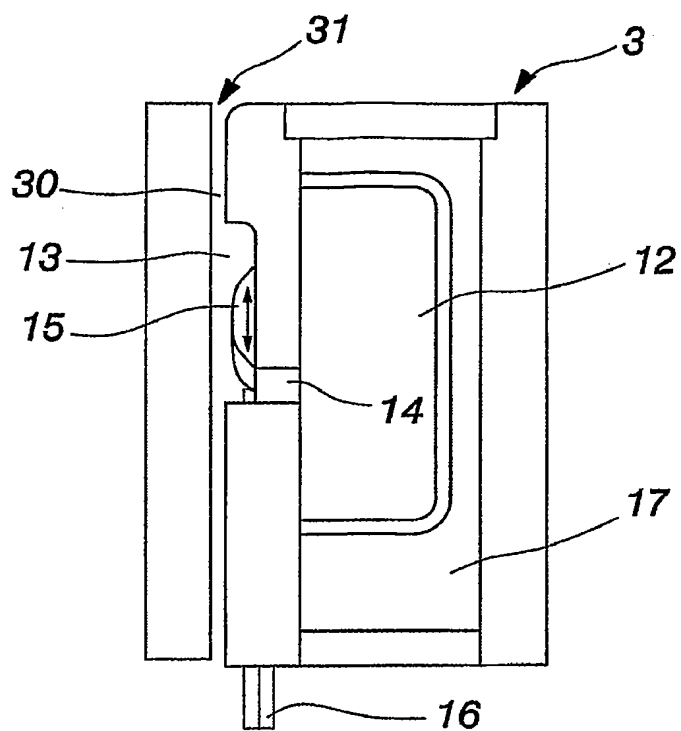
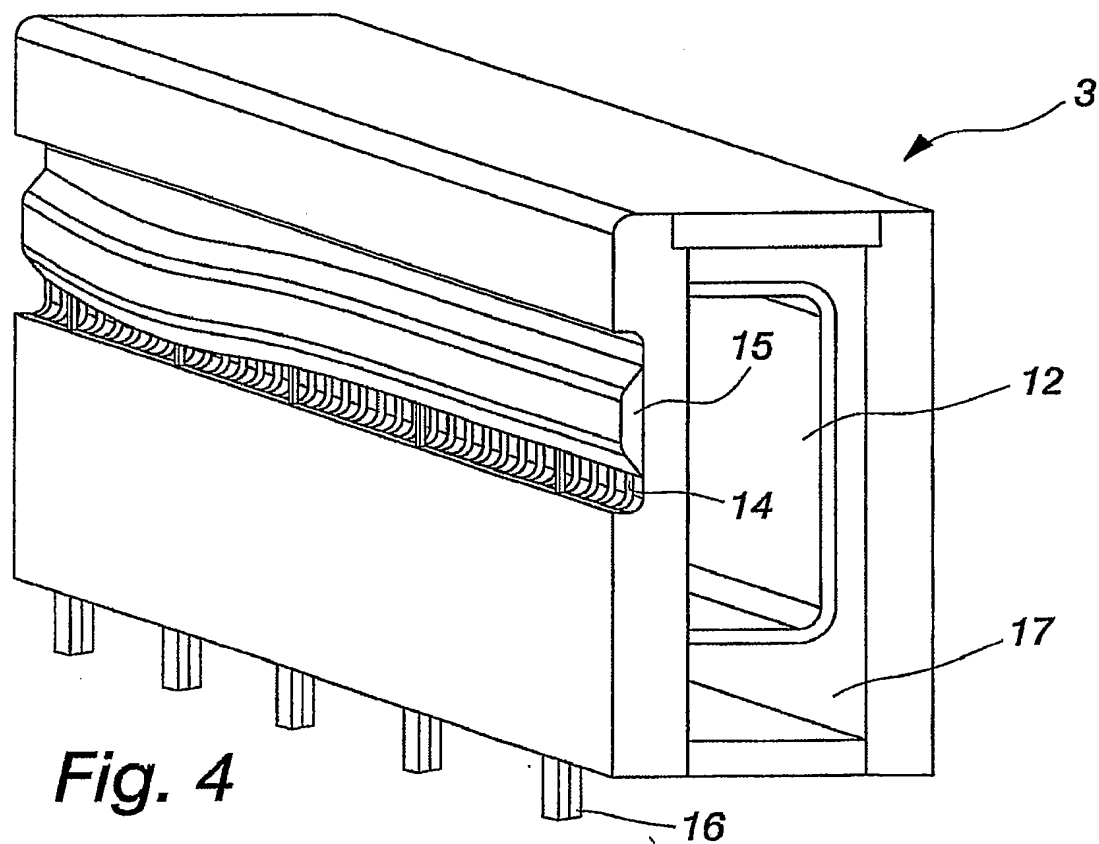
which the profiling member (15) can be deviated perpendicularly to its longitudinal direction in order to cover or uncover the feed holes (14) to the desired extent.

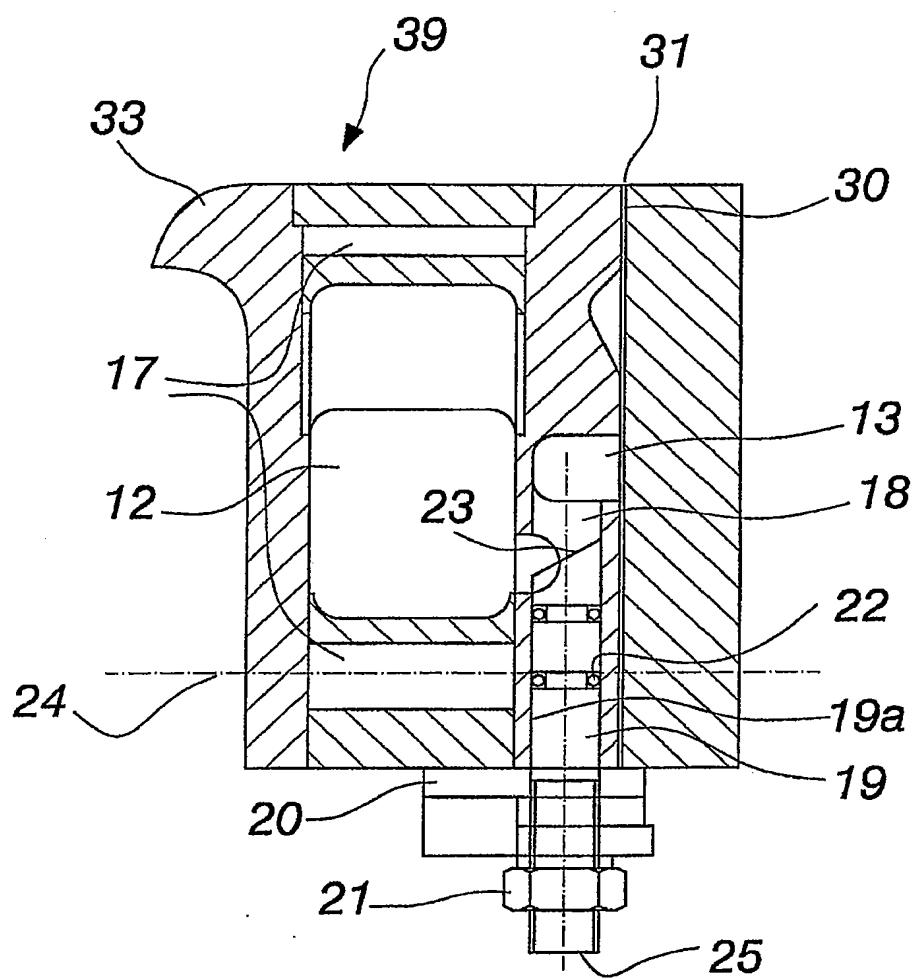
4. A coating apparatus as claimed in claim 1, **characterised** in that as an  
5 adjustment means for the area of the feed holes (18) is an adjusting pin (19)  
connected to each feed hole respectively, which pin is movable in its longitudinal  
direction for changing the effective area of each feed hole as desired.
5. A coating apparatus as claimed in claim 4, **characterised** in that in the feed  
10 holes (18) is formed a bore (19a) opening to the outside of the nozzle part, in which  
bore the adjusting pin (19) is located movably in its longitudinal direction, extending  
at its inner end (23) into the feed hole 18 for changing its effective cross-sectional  
area.
- 15 6. A coating apparatus as claimed in claim 4 or 5, **characterised** in that the end  
(23) of the adjusting pin (19) in the feed hole (18) is bevelled.
7. A coating apparatus as claimed in any of the above claims, **characterised** in  
that it is made into a multi-layer coating apparatus with two or more feed slots (30).



*Fig. 1 (Prior art)*



**Fig. 3****Fig. 4**



*Fig. 5*

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2004/050122

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21H 23/48, B05C 5/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21H, B05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6126751 A (RICHARD BERNERT ET AL), 3 October 2000 (03.10.2000), figures 1-4, abstract --	1-7
A	EP 0838551 A1 (VALMET CORPORATION), 29 April 1998 (29.04.1998), figures 1,2, abstract --	1-7
A	EP 1249533 A1 (THE DOW CHEMICAL COMPANY), 16 October 2002 (16.10.2002), abstract --	1-7
P,A	WO 2004022240 A2 (STORA ENSO NORTH AMERICA CORP.), 18 March 2004 (18.03.2004), figures 1-3, abstract --	1-7

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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